

ORIGINAL ARTICLE

Four new species of *Phyllomyza* Fallén (Diptera: Milichiidae), with an updated key from China

Yuqiang Xi, Xinming Yin*

College of Plant Protection, Henan Agricultural University, Zhengzhou 450002, China

*Corresponding author, E-mail: xinmingyin@126.com

Abstract Four species of the genus *Phyllomyza* Fallén from China are described as new to science: *P. covexusa* **sp. nov.**, *P. glossophyllusa* **sp. nov.**, *P. obliquusa* **sp. nov.** and *P. ruiliensis* **sp. nov.** A key to the known species of *Phyllomyza* from China is presented. The specimens are deposited in the Insect Collection of Henan Agricultural University.

Key words Diptera, Phyllomyzinae, *Phyllomyza*, new species, China.

1 Introduction

The genus *Phyllomyza* was erected by Fallén (1810) under the family Milichiidae Fallén, 1810 (Diptera: Brachycera). It is a small genus with 47 known species, distributed globally with exception of the Neotropical Region (Malloch, 1914a; Hennig, 1937, 1967; Papp, 1976, 1984; Papp & Wheeler, 1998; Yang, 1998; Brake, 2000; Iwasa, 2003; Xi & Yang, 2013, 2015a, b, 2016). The genus is characterized by the following characteristics: three lateroclinate orbital setae; palpus and the first flagellomere in male usually greatly enlarged; lunule usually with a pair of setae (Brake, 2000). Some larvae of *Phyllomyza* have been reared from nests of *Lasius fuliginosus* and *Formica rufa*, where they live in the chambers and galleries at the bottom of the nest (Donisthorpe, 1927). Adults can be collected in open landscapes, such as meadows, at the edges of forests, inside forests (Brake, 2000).

The genus is widely distributed all over the world except the Neotropical Region, including 16 species distributed in the Palearctic Region, 28 species in the Oriental Region and 3 species separately distributed in the African, Nearctic and Australian Regions. So far, 20 species have been recognized in China (Hendel, 1914; Malloch, 1914b; Yang, 1998; Xi & Yang, 2013, 2015a, b, 2016). In this paper, 4 new species of this genus from Yunnan are described, namely *P. covexusa* **sp. nov.**, *P. glossophyllusa* **sp. nov.**, *P. obliquusa* **sp. nov.** and *P. ruiliensis* **sp. nov.** A key to the known species of the *Phyllomyza* from China is presented.

2 Materials and methods

Genitalia preparations were made by removing and macerating the apical portion of the abdomen in cold saturated NaOH for 6 hours. After examination, they were transferred to fresh glycerine and stored in a microvial on the pin below the specimen or moved to an ethanol tube together with the wet specimens. The type specimens are deposited in the Insect Collection of Henan Agricultural University, Zhengzhou, Henan, China (HAU). The general terminology follows McAlpine (1981) and Brake (2000).

The abbreviations are used as following:

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asc—apical scutellar seta(e);
 bsc—basal scutellar seta(e);
 dc—dorsocentral seta(e);
 h—humeral seta(e);
 ia—intraalar seta(e);
 kepsts—katepisternal seta(e);
 npl—notopleural seta(e);
 pa—postalar seta(e);
 pos—postsutural seta(e);
 prs—presutural seta(e);
 prsc—prescutellar seta(e);
 sa—supraalar seta(e);
 S—sternite;
 T—tergite.

3 Taxonomy

Key to twenty four known species (males) of *Phyllomyza* from China.

1. Palpus almost bare, without setulae 2
 Palpus with short setulae at tip and on ventral side 7
2. Frons with 3 orbital setae; ocellar triangle brownish *P. fuscusa* Xi, Yin & Yang
 Frons with 4 orbital setae; ocellar triangle black 3
3. Cercus with short ventral appendix 4
 Cercus lacking ventral appendix 5
4. Palpus 3 times longer than wide; hind tibia brownish with 1/4 apical yellow *P. nudipalpis* Malloch
 Palpus 2 times longer than wide; hind tibia darkish brown with yellowish both ends *P. glossophyllusa* sp. nov.
5. Head black; ocellar triangle black *P. ruiiense* sp. nov.
 Head brown; ocellar triangle blackish brown 6
6. Palpus slightly longer, about 0.6 mm; first flagellomere irregularly subsquare, 2 times wider than long
 *P. leioipalpus* Xi, Yin & Yang
 Palpus length 0.4 mm; first flagellomere almost the same length and width *P. aureolusa* Xi, Yin & Yang
7. Palpus slightly longer, at least 0.6 mm long 8
 Palpus length less than 0.6 mm 9
8. First flagellomere irregularly trapezoidal; knob of halter yellowish white *P. basilatula* Xi, Yin & Yang
 First flagellomere irregularly rectangular; knob of halter darkish brown *P. sinensis* Xi & Yang
9. Halter orange brown; cercus with ventral appendix *P. epitacta* Hendel
 Halter yellowish white; cercus lacking ventral appendix 10
10. Palpus length 0.2 mm, pointed apically; first flagellomere hammer-shaped *P. claviconis* Yang
 Palpus inflated, blunted apically; first flagellomere approximately circular or sector 11
11. First flagellomere irregular sector *P. covexusa* sp. nov.
 First flagellomere approximately circular 12
12. M_1 between r-m and dm-cu as long as dm-cu 13
 M_1 between r-m and dm-cu longer than dm-cu 14
13. Gena narrow, approximately one-eleventh eye height; palpus long, 5 times as long as wide *P. angustigenis* Xi & Yang
 Gena relatively broad, approximately one-seventh eye height; palpus long, 7 times as long as wide *P. euthyipalpis* Xi & Yang
14. M_1 between r-m and dm-cu at least 1.5 times longer than dm-cu 15
 M_1 between r-m and dm-cu less than 1.2 times longer than dm-cu 19
15. Vibrissa located at level of lower eye margin 16
 Vibrissa located below level of lower eye margin 17
16. Palpus yellow, protruding, but not much broadened; hind tibia yellowish *P. luteipalpus* Malloch
 Palpus dark brown, thick, slightly broad; hind tibia yellow to brown *P. clavellata* Xi & Yang
17. Halter white; palpus sickle-shaped *P. drepanipalpis* Xi & Yang
 Halter dark brown or yellowish; palpus slightly flat and straight 18
18. Gena approximately one-seventh eye height; knob of halter yellowish *P. emeishanensis* Xi & Yang

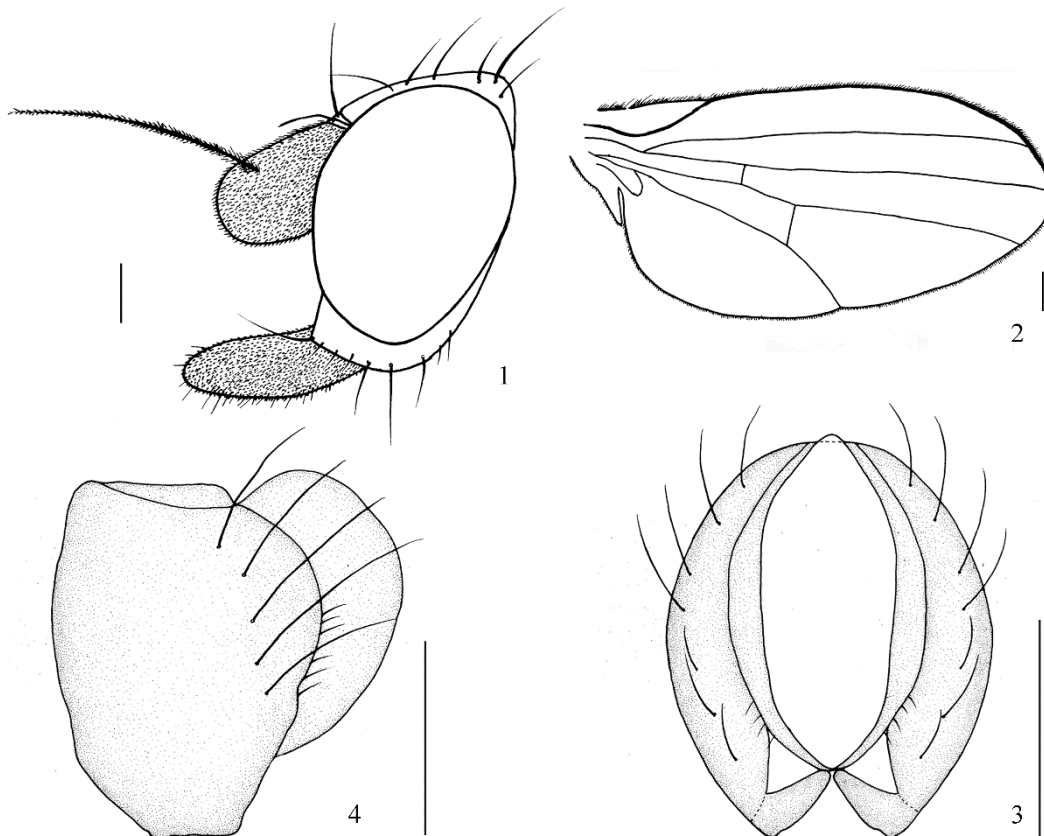
- Gena approximately one-fifth eye height; knob of halter with upper half white and lower half dark brown *P. latustigenis* Xi & Yang
19. First flagellomere irregularly circular 20
 First flagellomere irregularly trapezoidal *P. dicrana* Xi & Yang
20. Vibrissal angle relatively acute 21
 Vibrissal angle flat and blunt 22
21. Ocellar triangle brownish; palpus long oval with dense black setulae *P. cuspidata* Xi & Yang
 Ocellar triangle black; palpus thick rodlike with blunt apex *P. obliquosa* sp. nov.
22. Cercus with thin ventral appendix; hind tibia brownish *P. dilatata* Malloch
 Cercus lacking short ventral appendix; hind tibia dark brown 23
23. Palpus wide, knife-shaped, 2.6 times longer than wide; knob of halter with upper half brownish and lower half dark brown *P. planipalpis* Xi & Yang
 Palpus basally wide and apically narrowed; knob of halter with upper half yellow and under half yellowish *P. tibetensis* Xi & Yang

***Phyllomyza convexusa* sp. nov.** (Figs 1–4)

Diagnosis. This new species is somewhat similar to *P. dilatata* Malloch, but differs from the gena approximately one-seventh of eye height; knob of halter brown yellow, stalk brown; cercus without ventral appendix. In *P. dilatata*, the gena approximately one-ninth of eye height; knob of halter yellowish white, stalk yellowish; cercus with longer ventral appendix, 1 seta on ventral appendix (Malloch, 1914b).

Description. Male. Body length 1.7 mm; wing length 1.6 mm.

Head (Fig. 1) black with grayish microtomentum. Orbital plate subshiny black with microtomentum, ocellar triangle blackish brown without microtomentum; lunule strap-shaped, darkish brown with black margin. Posterior eye margin ventrally diverging from head margin, eye 1.6 times as high as long, gena approximately one-seventh of eye height. Setae and setulae on head black; ocellar triangle with 2 long ocellar setae and 3 short setae; frons with 3 orbital and 2 frontal setae



Figures 1–4. *Phyllomyza convexusa* sp. nov., male. 1. Head, lateral view. 2. Wing. 3. Epandrium, cerci, and surstyli, posterior view. 4. Epandrium, cerci, and surstyli, lateral view. Scale bars=0.1 mm.

on black orbital stripe, orbital setae laterocline and frontal setae mediocline, 4 interfrontal setae; postocellar setae cruciate. Lunule with 2 setae. Vibrissal angle relatively rectangular; vibrissa strong and located at level of lower eye margin. Antenna blackish brown with brownish microtomentum; pedicel with black setulae at middle and margin, setulae at margin longer than others, two longer setae, longest one about 2 times longer than the other one, about 3.5 times longer than the others; first flagellomere with pubescence, irregular sector; arista darkish brown, distinctly dense pubescence, 3.3 times as long as first flagellomere. Proboscis fold, darkish yellow at anterior 1/2, the rest part darkish brown, with sparse setulae. Palpus slightly rod-like with blunt apex in lateral view, about 0.3 mm, 3.5 times longer than wide; darkish brown with short dense brown pubescence, margin with sparse setulae.

Thorax darkish brown with grey microtomentum, except mesonotum shiny darkish brown; scutellum blackish brown with gray microtomentum. Setae and setulae on thorax black; 1 h, 2 dc, 1 prsc, 2 npl, 1 prs, 1 pos, 1 sa, 2 pa, 1 kepsts (a row setulae at forward position); scutellum 1.3 times wider than long, with pair of asc and bsc, asc 3 times longer than bsc. Legs slender, coxae and femora darkish brown, tibiae yellow except hind tibia darkish brown at posterior 2/3, tarsi yellowish. Setae and setulae on legs black. Mid tibia with 1 black preapical dorsal seta. Wing (Fig. 2) hyaline; veins brown; Sc strong; M_1 between r-m and dm-cu longer than dm-cu. Calypter yellowish, with dense brownish microtrichae, margin with brownish setulae. Knob of halter brown yellow.

Abdomen yellowish brown with gray microtomentum. Setae and setulae on abdomen black; T2–T5 with setae at posterior 3/4, marginal setae longer than others; sternites with sparse black setulae. Posteromedial triangular projection of T1 into T2 strong; S2 generally horseshoe-shaped, S3 and S4 irregularly vertical rectangular; S5 generally saddle-shaped, 1.2 times wider than long. Male genitalia (Figs 3–4). Epandrium with 7 pairs of strong setae; surstylus tip slightly swollen and apical slightly blunt; cercus arched and with short sparse setae.

Female. Unknown.

Material examined. Holotype ♂, China, Yunnan, Baoshan, Baihualing (25°17'N, 98°48'E; elev. 1370 m), 12.V.2012, coll. Yuanye Liu. Paratypes. 2♂, same data as holotype; 3♂, China, Yunnan, Baoshan, Baihualing (25°17'N, 98°48'E; elev. 1372 m), 12.V.2012, coll. Wenliang Li. All deposited in HAU.

Distribution. China (Yunnan).

Etymology. The specific name refers to the apical abdomen of male swollen.

Phyllomyza glossophyllusa sp. nov. (Figs 5–6)

Diagnosis. This new species is somewhat similar to *P. nudipalpis* Malloch, but differs from the genus approximately one-sixth of eye height; knob of halter darkish brown, stalk brown. In *P. nudipalpis*, the genus approximately one-eighth of eye height; knob of halter yellow white, stalk yellow (Malloch, 1914b).

Description. Male. Body length 1.9 mm; wing length 2.1 mm.

Head (Fig. 5) black with grayish microtomentum. Orbital plate subshiny black with microtomentum, ocellar triangle black without microtomentum; lunule strap-shaped, dark yellow with brownish yellow margin. Posterior eye margin ventrally diverging from head margin, eye 1.3 times as high as long, gena approximately one-sixth eye height. Setae and setulae on head black; ocellar triangle with 2 long ocellar setae and 3 short setae; frons with 3 orbital and 2 frontal setae on darkish brown orbital stripe, orbital setae laterocline and frontal setae mediocline, 4 interfrontal setae; postocellar setae cruciate. Lunule with 2 setae. Vibrissal angle relatively right-angle, vibrissa strong and located at level of lower eye margin. Antenna blackish brown with brownish microtomentum; pedicel with short black setulae at middle and margin, setulae at margin longer than others, longest one about 3 times longer than the others; first flagellomere with pubescence, irregularly square; arista black, with short pubescence, 2.5 times as long as first flagellomere. Proboscis relatively long, darkish yellow with sparse setulae. Palpus thick and long, basal wide and enlarged, apical gradually narrowed in lateral view, about 0.6 mm; blackish brown with short dense black pubescence, margin with obviously short sparse setulae.

Thorax darkish brown with grey microtomentum, except mesonotum shiny darkish brown; scutellum darkish brown with gray microtomentum. Setae and setulae on thorax black; 1 h, 2 dc, 1 prsc, 2 npl, 1 prs, 1 sa, 1 pa, 1 kepsts (9 setulae at forward position); scutellum 2 times wider than long, with pair of asc and bsc, asc 3 times longer than bsc. Legs slender, coxae and femora darkish brown, tibiae darkish yellow except hind tibia darkish brown with yellowish both ends, tarsi yellowish. Setae and setulae on legs black. Mid tibia with 1 black preapical dorsal seta. Wing (Fig. 6) hyaline; veins brown; Sc strong; M_1 between r-m and dm-cu longer than dm-cu. Calypter yellowish, with dense brownish microtrichae and margin with brownish setulae. Knob of halter yellowish white.

Abdomen darkish brown with gray microtomentum. Setae and setulae on abdomen black; T2–T5 with setae, marginal setae longer than others; sternites with sparse black setulae at posterior 3/4. Posteromedial triangular projection of T1 into T2 weak; S2 generally horseshoe-shaped and apical margin slightly sharp, S3 vertically rectangular, S4 horizontally

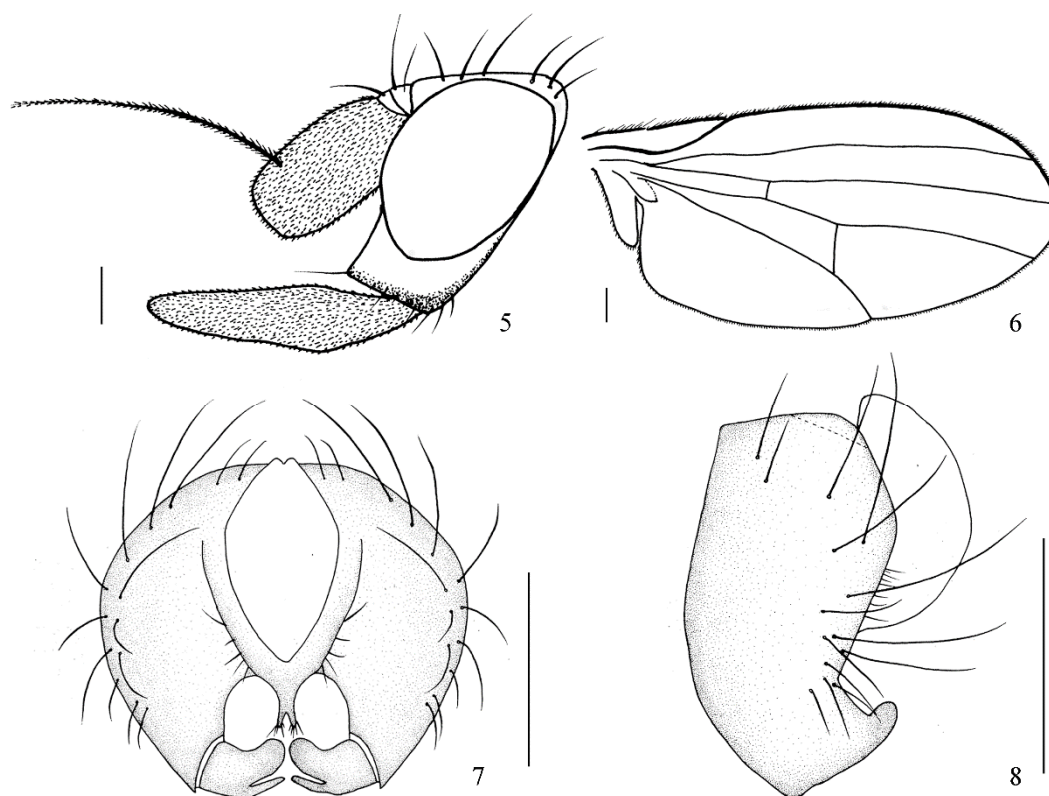
rectangular, longer than S5, S5 generally horizontally rectangular, apical margin flat and smooth, 2.3 times longer than wide. Male genitalia (Figs 7–8). Epandrium extremely circular with 14 pairs of strong setae; surstylus with upper blade extremely swollen and lower one slightly thin; cercus arched and with short sparse setae.

Female. Unknown.

Material examined. Holotype ♂, China, Yunnan, Dali, Cangshan (25°41'N, 100°08'E; elev. 2100 m), 3.VI.2012, coll. Yuyu Wang. Paratypes. 1♂, same data as holotype; 1♂, China, Yunnan, Baoshan, Dashaoping (25°19'N, 99°12'E; elev. 1925 m), 4.V.2012, coll. Yuanye Liu; 3♂, China, Yunnan, Baoshan, Dashaoping (25°19'N, 99°12'E; elev. 1925 m), 5.V.2012, coll. Wenliang Li; 1♂, China, Yunnan, Tengchong, Zizhi (25°43'N, 98°34'E; elev. 1650 m), 7.V.2012, coll. Yuanye Liu; 3♂, China, Yunnan, Tengchong, Datang (25°37'N, 98°40'E; elev. 1850 m), 8.V.2012, coll. Wenliang Li. All deposited in HAU.

Distribution. China (Yunnan).

Etymology. The specific epithet refers to the shaped of palpus.



Figures 5–8. *Phyllomyza glossophyllusa* sp. nov., male. 5. Head, lateral view. 6. Wing. 7. Epandrium, cerci, and surstyli, posterior view. 8. Epandrium, cerci, and surstyli, lateral view. Scale bars=0.1 mm.

Phyllomyza obliquusa sp. nov. (Figs 9–12)

Diagnosis. This new species is somewhat similar to *P. angustigenis* Xi & Yang, but differs from the gena approximately one-ninth of eye height; knob of halter with the upper half brownish black and the lower greyish white; the surstylus with upper blade of bifurcated extremely swollen. In *P. angustigenis*, the gena approximately one-eleventh of eye height; knob of halter white; the surstylus with upper blade of bifurcated slightly swollen (Xi & Yang, 2013).

Description. Male. Body length 1.6 mm; wing length 1.6 mm.

Head (Fig. 9) black with grayish microtomentum. Orbital plate subshiny black with microtomentum, ocellar triangle black without microtomentum; lunule strap-shaped, dark yellow with brownish yellow margin. Posterior eye margin ventrally diverging from head margin, eye 1.3 times as high as long, gena approximately one-ninth eye height. Setae and setulae on head black; ocellar triangle with 2 long ocellar setae and 3 short setae; frons with 3 orbital and 2 frontal setae on darkish brown stripe, orbital setae laterocline and frontal setae mediocline, 4 interfrontal setae; postocellar setae cruciate. Lunule with 2 setae. Vibrissal angle relatively blunt, vibrissa strong and located at level of lower eye margin. Antenna blackish brown with brownish microtomentum; pedicel with short black setae at middle and margin, longest one about 4

times longer than others; first flagellomere with pubescence, irregularly circular; arista black, distinctly pubescent, 3.5 times as long as first flagellomere. Proboscis short and folded, darkish yellow with short sparse black setulae. Palpus darkish brown, thick rodlike with blunt apex, basal thicker than apical in lateral view, about 0.4 mm, 5 times longer than wide, margin with short sparse black setae.

Thorax darkish brown with grey microtomentum, except mesonotum shiny blackish brown with sparse black microtomentum; scutellum darkish brown with gray microtomentum. Setae and setulae on thorax black; 1 h, 2 dc, 1 prsc, 2 npl, 1 prs, 1 sa, 1 pa, 1 kepsts (a row setulae at forward position); scutellum 2 times wider than long, with pair of asc and bsc, asc 3 times longer than bsc. Legs slender, coxae and femora darkish brown, tibiae dark brown except fore tibia darkish yellow with yellowish both ends, tarsi yellowish. Setae and setulae on legs black. Mid tibia with 1 black preapical dorsal seta. Wing (Fig. 10) hyaline; veins brown; Sc strong; M_1 between r-m and dm-cu much longer than dm-cu. Calypter yellowish, with dense brownish microtrichae and margin with long setulae. Knob of halter with the upper half brownish black and the lower greyish white.

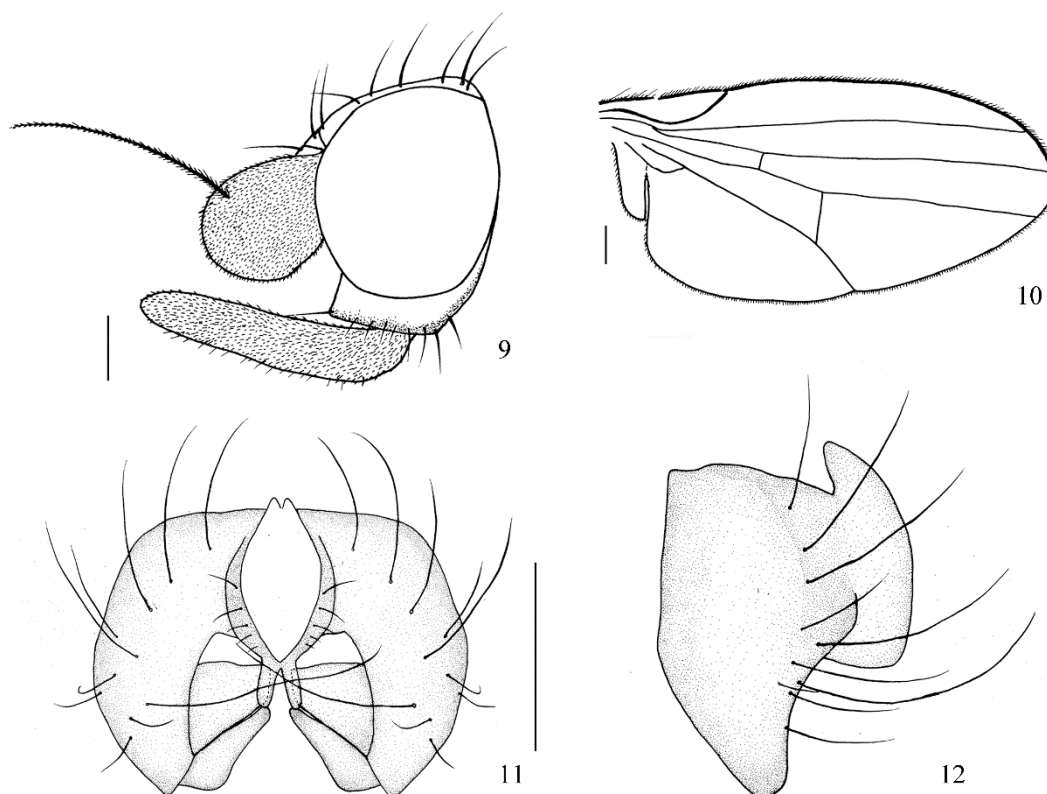
Abdomen darkish brown with gray microtomentum. Setae and setulae on abdomen black; T2–T5 with setae, marginal setae longer than others; sternites with sparse black setulae at posterior 3/4. Posteromedial triangular projection of T1 into T2 strong; S2 approximately trapezoid-shaped, apical margin 2 times wider than basal margin, S3 and S4 generally trapezoidal, the apical margin 1.5 times wider than basal margin, S5 horizontally rectangular, the apical margin slightly arched, 2 times longer than wide. Male genitalia (Figs 11–12). Epandrium with 10 pairs of strong setae; surstylus with upper blade of bifurcated tip extremely swollen and lower one relatively thin; cercus arched and with short sparse setae, the bottom margin with two protuberancies, covered parts of surstylus.

Female. Unknown.

Material examined. Holotype ♂, China, Yunnan, Yingjiang, Tongbiguan (24°36'N, 97°39'E; elev. 1350 m), 1.V.2012, coll. Wenliang Li. Paratypes. 3♂, same data as holotype; 3♂, China, Yunnan, Tengchong, Datang (25°37'N, 98°40'E; elev. 1850 m), 8.V.2012, coll. Wenliang Li; 2♂, China, Yunnan, Baoshan, Dashaoping (25°19'N, 99°12'E; elev. 1925 m), 4.V.2012, coll. Yuanye Liu. All deposited in HAU.

Distribution. China (Yunnan).

Etymology. The specific epithet refers to the inclined dm-cu.



Figures 9–12. *Phyllomyza obliquusa* sp. nov., male. 9. Head, lateral view. 10. Wing. 11. Epandrium, cerci, and surstyli, posterior view. 12. Epandrium, cerci, and surstyli, lateral view. Scale bars=0.1 mm.

***Phyllomyza ruiliensis* sp. nov.** (Figs 13–16)

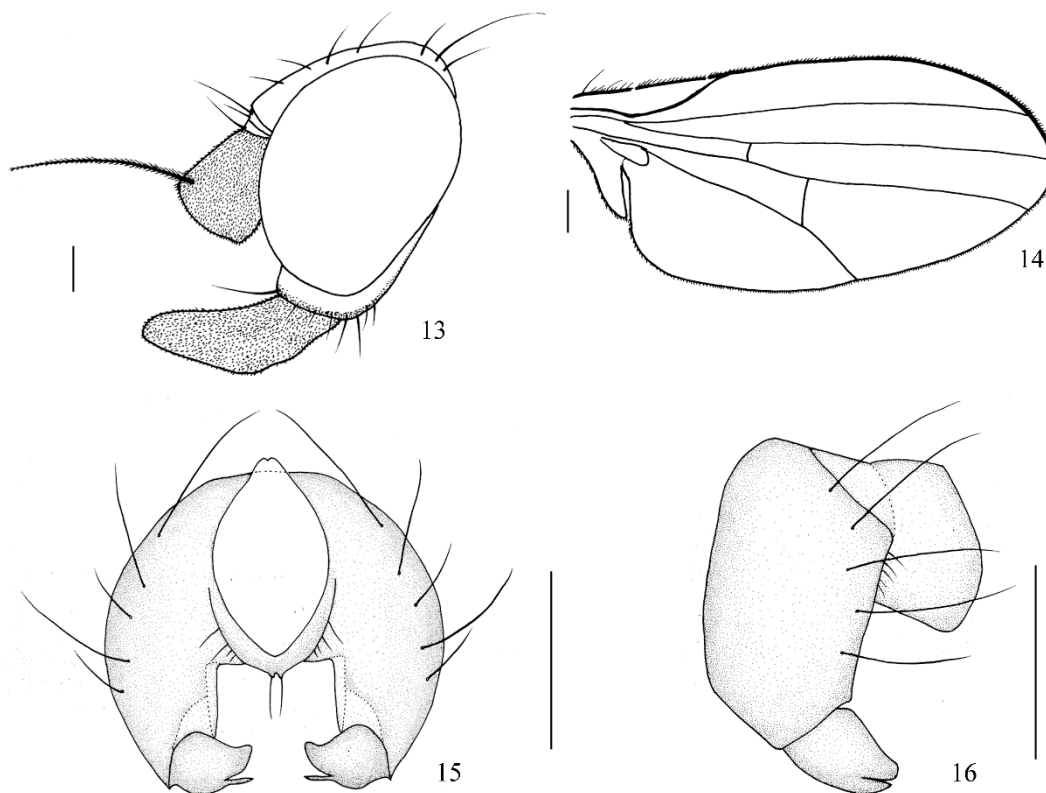
Diagnosis. This species is similar to *P. cuspidata* Xi & Yang, but can be separated easily from the latter by the gena approximately one-eleventh eye height; surstylus with upper blade of bifurcation tip extremely swollen, the lower one thin. In *P. cuspidata*, the gena approximately one-eighth eye height; surstylus with upper blade of bifurcation tip slightly swollen, the lower one sharp at tip (Xi & Yang, 2013).

Description. Male. Body length 1.5 mm; wing length 1.6 mm.

Head (Fig. 13) black with grayish microtomentum; orbital plate subshiny black with microtomentum, ocellar triangle black without microtomentum; lunule strap-shaped, yellow with brownish yellow margin. Posterior eye margin ventrally diverging from head margin; eye 1.4 times as high as long, gena approximately one-eleventh eye height. Setae and setulae on head black; ocellar triangle with 2 ocellar setae and 3 short setae; frons with 3 orbital and 2 frontal setae on darkish brown stripe, orbital setae laterocline and frontal setae mediocline, 4 interfrontal setae; postocellar setae cruciate. Lunule with 2 setae. Vibrissal angle relatively blunt; vibrissa strong, located at the level of lower eye margin. Antenna blackish brown with microtomentum; pedicel with short black setulae at middle and margin, setulae at margin longer than others, longest one about 3 times longer than others; first flagellomere with pubescence, irregularly square; arista 3 times as long as first flagellomere, black, distinctly pubescent. Proboscis slightly short and folded, darkish yellow, margin with sparse setulae. Palpus wide and flat, base to apical gradually narrowed in lateral view, about 0.4 mm; yellowish brown with short dense black pubescence, margin with sparse short setulae.

Thorax darkish brown with grey microtomentum, except mesonotum shiny blackish brown with sparse black microtomentum; scutellum darkish brown with gray microtomentum. Setae and setulae on thorax black; 1 h, 2 dc, 1 prsc, 2 npl, 1 prs, 1 sa, 1 pa, 1 kepsts (7 setulae at forward position); scutellum 2 times wider than long, with pair of asc and bsc, asc 3 times longer than bsc. Legs slender, coxae and femora darkish brown, tibiae darkish yellow except hind tibia darkish brown with yellowish both ends, tarsi yellowish. Setae and setulae on legs black. Mid tibia with 1 black preapical dorsal seta. Wing (Fig. 14) hyaline, unspotted; veins brown; Sc strong; M_1 between r-m and dm-cu longer than dm-cu. Calypter yellowish, with dense brownish microtrichae, margin with thin setulae. Knob of halter yellowish white.

Abdomen darkish brown with gray microtomentum. Setae and setulae on abdomen black; T2–T5 with setae, marginal



Figures 13–16. *Phyllomyza ruiliensis* sp. nov., male. 13. Head, lateral view. 14. Wing. 15. Epandrium, cerci, and surstyli, posterior view. 16. Epandrium, cerci, and surstyli, lateral view. Scale bars=0.1 mm.

setae longer than others; sternites with sparse black setulae at posterior 3/4. Posteromedial triangular projection of T1 into T2 strong; S2 irregularly horseshoe-shaped and the apical margin slightly sharp, S3 vertically rectangular, S4 irregularly horizontal rectangular, S5 horizontal trapezoid-shaped, the apical margin flat and smooth, 1.8 times wider than long. Male genitalia (Figs 15–16). Epandrium with 5 pairs of strong black setae at middle; surstylus with upper blade of bifurcation tip swollen, short and apical blunted, the lower one thin; cercus arched with short sparse setae.

Female. Unknown.

Etymology. The specific epithet refers to the type locality, Ruili botanical garden.

Material examined. Holotype ♂, China, Yunnan, Dehong, Ruili (24°0'N, 97°51'E; elev. 800 m), 30.IV.2012, coll. Yuanye Liu. Paratypes. ♂, China, Yunnan, Dehong, Ruili (24°0'N, 97°51'E; elev. 800 m), 30.IV.2012, coll. Wenliang Li. All deposited in HAU.

Distribution. China (Yunnan).

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